Examiners' Report
Lead Examiner Feedback

June 2022

Pearson BTEC Nationals
In Applied Science (31619H)
Unit 3: Science Investigation Skills

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Grade Boundaries

What is a grade boundary?

A grade boundary is where we set the level of achievement required to obtain a certain grade for the externally assessed unit. We set grade boundaries for each grade, at Distinction, Merit and Pass.

Setting grade boundaries

When we set grade boundaries, we look at the performance of every learner who took the external assessment. When we can see the full picture of performance, our experts are then able to decide where best to place the grade boundaries – this means that they decide what the lowest possible mark is for a particular grade.

When our experts set the grade boundaries, they make sure that learners receive grades which reflect their ability. Awarding grade boundaries is conducted to ensure learners achieve the grade they deserve to achieve, irrespective of variation in the external assessment.

Variations in external assessments

Each external assessment we set asks different questions and may assess different parts of the unit content outlined in the specification. It would be unfair to learners if we set the same grade boundaries for each assessment, because then it would not take accessibility into account.

Grade boundaries for this, and all other papers, are on the website via this link

Awarding BTEC qualifications in 2022

Ofqual has set out their plans for awarding qualifications in 2022 and intend to return to a normal, pre-pandemic, approach to grading standards over by 2023. They have confirmed that 2022 will be a transition year, to reflect that we are in a pandemic recovery period and students' education has been disrupted.

Our guiding principle and approach to awarding BTEC qualification results in 2022 will be to ensure parity in relation to the approach being taken for GCSE and A level learners. BTEC courses have a different structure and design to academic qualifications - BTECs are modular qualifications (with assessments taking place throughout the course) compared to GCSEs and A levels which

are linear (assessed and awarded at the same time at the end of the year), and therefore our approach needs to be different.

In 2022 we will return to the usual method of calculating BTEC qualification results, however adaptations including, U-TAGs and reduced internal assessment, are in place to provide a comprehensive package of support for students.

The basis of our awarding approach to BTECs this year is to ensure it is as fair as possible for all learners. We will use a range of evidence to set grade boundaries for the external units. Part of this evidence will be to closely monitor learner performance in all assessments that contribute to learners' final qualification grade, to ensure parity with A level and GCSEs.

Further information can be found on our website and via our Social Media channels.

Introduction

Chemistry (Section 1)

This was the second time this paper has been sat since the pandemic. Learners were given 45 minutes to read Part A and make notes for Part B. The Part A detailed an investigation into the amount of energy that is released in one minute when alcohols are burned, which had been carried out by a trainee technician. Learners were given the title and aim of the experiment, an introduction, equipment list, method and raw data.

Introduction to the Overall Performance of the Unit

Learners that did well were obviously familiar with the experiment carried out by the trainee technician in Part A. They were able to present and analyse the raw data and apply principles and ideas that they had learned to the given data. They were able to carry out calculations methodically, showing their working. Given new data they were also able to analyse and evaluate this.

Introduction

Biology (Section 2)

Section 2 of this paper consists of two questions which are taken from a different scientific discipline to the questions in Section 1. Section 2 of this paper focused the learners on their understanding of the biology part of the specification and concentrates, in Q4, on 'Planning a scientific Investigation' and, in Q5, on 'Drawing conclusions and evaluating'.

Introduction to the Overall Performance of the Unit

Learners that did well, approached their answers in a logical way, interacted with the stimulus in the question and gave their responses in a well-structured way, ensuring that they addressed everything asked of them in the question. They related their answers to the context set rather than generic answers.

Individual Questions

Chemistry (Section 1)

Q1(a)

This question asked learners to present the trainee technician's raw data in a table and in a bar chart. The question asked learners to record the data and to include an average temperature change. Many learners lost marks on this question, common errors were not including headings in the table, in particular for the average temperature change, or not recording data to a consistent number of decimal places. When calculating the average temperature change, learners often calculated it correctly but then rounded incorrectly therefore losing this mark.

Lead Examiner comment: *This example scored the full 3 marks available.*

1 (a) Record the trainee technician's raw data in a suitable table, using the space provided.

Your table must include an average temperature change for the water for each alcohol used.

(3)

number of carbon atoms per molecule	temperature change °C			
	1	2	3	mean
1	12.5	11.5	12.0	12.0
2	9.0	9.5	9.0	9.2
3	7.0	7.5	7.0	7.2
4	6.0	7.0	6.5	6.5
5	5.0	4.5	4.0	4.5

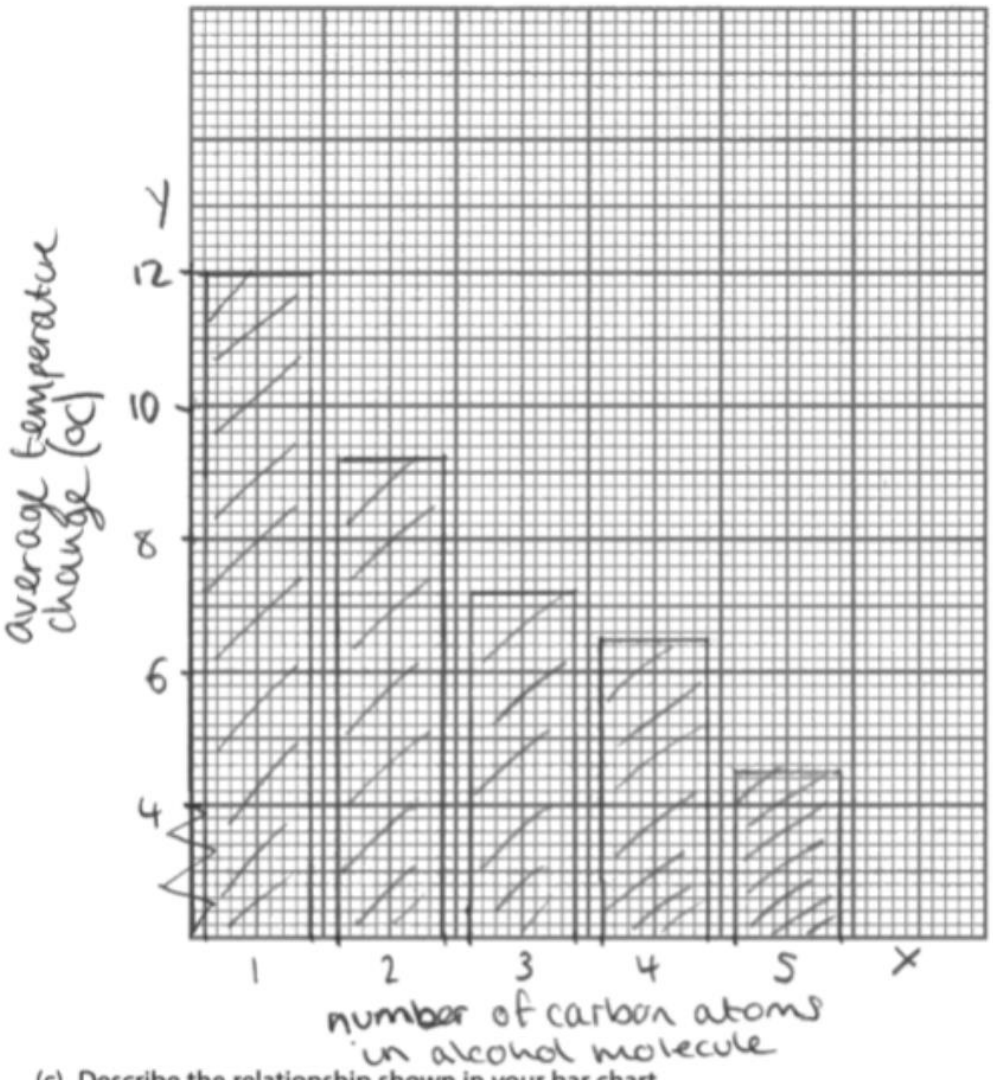
Q1(b)

Learners were then asked to present this data as a bar chart, this was generally well done with fewer losing marks. Where marks were lost it was often for omitting the labels or units on the axes. The question clearly asked learners to plot the temperature change against the number of carbon atoms in each type of molecule, whilst learners were not penalised if they had plotted against the name of each alcohol rather than the number of carbon atoms, this then put them at a disadvantage for Q1(c) as the trend was much harder to see. Where learners had made an error in calculating the averages, this was carried through, and marks not penalised in Q1(b). It was pleasing to see that the majority of learners were able to scale their graphs correctly and drawn the bars accurately.

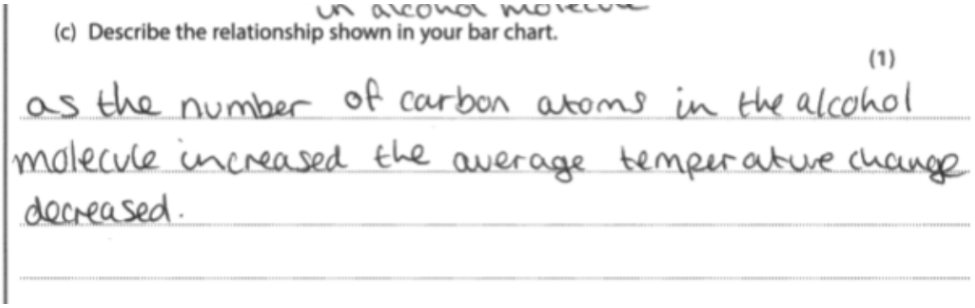
Lead Examiner comment: *This example shows a good bar chart that gained the full 3 marks available.*

(b) Draw a bar chart of the average temperature change against the number of carbon atoms in each type of alcohol molecule.

(3)



Lead Examiner comment: *Whilst the trend appears easy to see in this graph, where learners had not read the question carefully and followed instructions, the trend was less easy to see and the mark often lost. In the example, the learner gained the mark for the simple trend*.



(c) Describe the relationship shown in your bar chart.

(1)

as the number of carbon atoms in the alcohol molecule increased the average temperature change decreased.

Q1(d)

Learners found it hard to state why a bar chart is more appropriate than a line graph to show the relationship with many just stating that it was easier to draw or easier to read. Of those that did score, many often stated that it was categoric which gained the mark and some understood that partial carbon atoms do not exist so a bar chart would be more appropriate.

Lead Examiner comment: *This example gained 1 mark.*

(d) The bar chart displays the average temperature change against the number of carbon atoms per molecule in each alcohol.

State why a bar chart is more appropriate than a line graph to show this relationship.

(1)

it is discontious data and categoric data

Q1(e)

Focused on the health and safety in the investigation. Learners were told that the alcohol burners display a hazard symbol showing that the contents were flammable, they were then asked for a risk to the trainee technician when using an alcohol burner. It was pleasing to see that the majority knew the difference between a risk and a hazard and stated that the risk would be burns to the technician, however when asked for a precaution used to prevent this risk, many gave very generic risks such as wearing goggles, gloves or PPE or simply stated to be careful. Many gave a long list some of which were non creditworthy.

Lead Examiner comment: *In this example, the learner scored the mark for the risk but did not gain the mark for the precaution to reduce the risk.*

(e) The trainee technician used alcohol burners in the investigation.

Each alcohol burner displays a hazard symbol showing that the contents are flammable.

(i) State the risk to the trainee technician when using an alcohol burner.

(1)

The technician could get burnt

(ii) Give **one** precaution that the trainee technician should take to reduce this risk.

(1)

wear gloves, goggles, protective clothing. Because,

Lead Examiner comment: *In this example, the learner gained 1 mark for the risk and then a second in Q1(e)(ii) for stating that they should let the burner cool before putting it away which gained the mark.*

(e) The trainee technician used alcohol burners in the investigation.

Each alcohol burner displays a hazard symbol showing that the contents are flammable.

(i) State the risk to the trainee technician when using an alcohol burner.

(1)

They can burn their skin

(ii) Give **one** precaution that the trainee technician should take to reduce this risk.

(1)

before putting the burner away they should wait for it to cool down

Q1(f)

The question focused on some observations made by the trainee technician. Many were able to identify the black circle observed by the technician as soot produced by the alcohol, fewer explained that this was due to the incomplete combustion of the fuel to gain the second mark.

Lead Examiner comment: *This example shows a good response which gained both marks available.*

(f) The trainee technician made the following observation after the combustion of pentan-1-ol.

'large black circle on bottom of conical flask'

Explain why the conical flask had a black mark on the bottom after burning the pentan-1-ol.

(2)

The combustion was incomplete and did not have a sufficient oxygen supply to efficiently burn all of the present carbon atoms, soot is given off.

Lead Examiner comment: *This example was too vague, if they had stated incomplete combustion of the alcohol a mark could have been awarded. Another common misconception was that the glass has burned, this also gained no credit.*

(f) The trainee technician made the following observation after the combustion of pentan-1-ol.

'large black circle on bottom of conical flask'

Explain why the conical flask had a black mark on the bottom after burning the pentan-1-ol.

(2)

black mark was due to combustion of alcohol

Q1(g)(i)

This question asked learners to calculate the percentage error in the volume of water measured.

Lead Examiner comment: *It was pleasing to see that the majority of learners knew how to calculate the percentage error. These learners often showed their working clearly and gained both marks.*

(g) The trainee technician used a measuring cylinder to measure out 80 cm^3 of water.

(i) The measuring cylinder had graduation marks of 1 cm^3.

Calculate the percentage error of the volume of water measured using the measuring cylinder.

Show your working.

(2)

$\frac{1.0}{2} = 0.5$

$\frac{0.5}{80} \times 100 = 0.625\%$

percentage error of measuring cylinder = 0.625 %

Lead Examiner comment: *However, many lost marks as they used 1 rather than 0.5 in their calculation. In this example, the learner scored 1 mark using the correct calculation but using 1 rather than 0.5.*

(g) The trainee technician used a measuring cylinder to measure out 80 cm^3 of water.

(i) The measuring cylinder had graduation marks of 1 cm^3.

Calculate the percentage error of the volume of water measured using the measuring cylinder.

Show your working.

(2)

$\frac{1}{80} = 0.0125$

percentage error of measuring cylinder = 0.0125

Q1(g)(ii)

Lead Examiner comment: *The majority of learners were able to name a piece of equipment that would measure the water more accurately with most suggesting the use of a pipette or a burette.*

(ii) Name a piece of equipment that would measure the water more accurately than a measuring cylinder.

(1)

burette

Lead Examiner comment: *Common incorrect answers seen were beaker, jog and ruler, these all gained no credit, as in this example.*

(ii) Name a piece of equipment that would measure the water more accurately than a measuring cylinder.

(1)

Beaker

Q1(g)(iii)

Learners found stating why the trainee technician stirred the water during heating more difficult, with many stating that it was to speed up the process or rate of reaction.
Some confused terms and stated that it was to distribute the temperature which was not accepted.

Lead Examiner comment: *Example of a response not scoring.*

(iii) State why the trainee technician stirred the water during heating.

(1)

To spread up the ~~process~~ Process.

Lead Examiner comment: *The following answer gained 1 mark for stating that the water was stirred to spread the heat throughout the flask.*

(iii) State why the trainee technician stirred the water during heating.

to spread out the heat energy throughout the conical flask (1)

Lead Examiner comment: *The majority of learners knew that to calculate the temperature change the initial temperature of the water was subtracted from the final temperature to gain the mark as in this example.*

(iv) Describe how the trainee technician calculated the temperature change of the water.

(1)

Measure initial tempurture then measure the final tempurture, then final – inital ~~to~~ to calculate tempurture change.

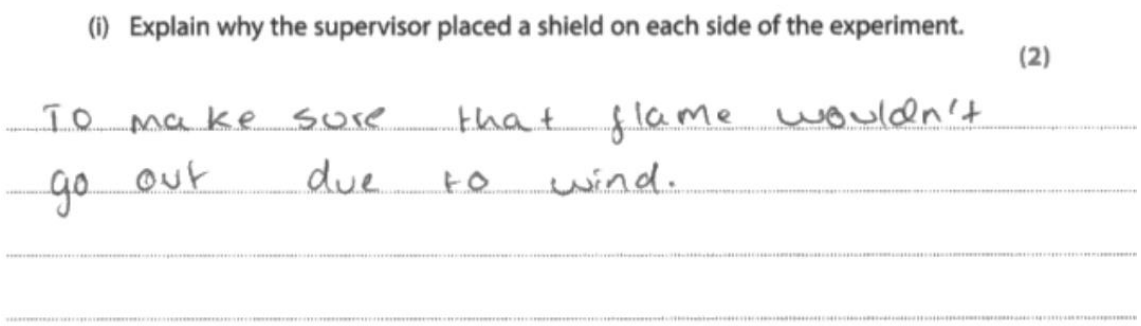
Q2

This question focused on the trainee technician's supervisor who carried out a similar investigation.

Q2(a)(i)

Learners were asked to explain why the supervisor placed a shield on each side of the experiment. The best answers referred to reducing heat loss and stopping draughts.

Lead Examiner comment: *This example shows an understanding that the shield would stop wind which would otherwise put the flame out. This gained 2 marks.*

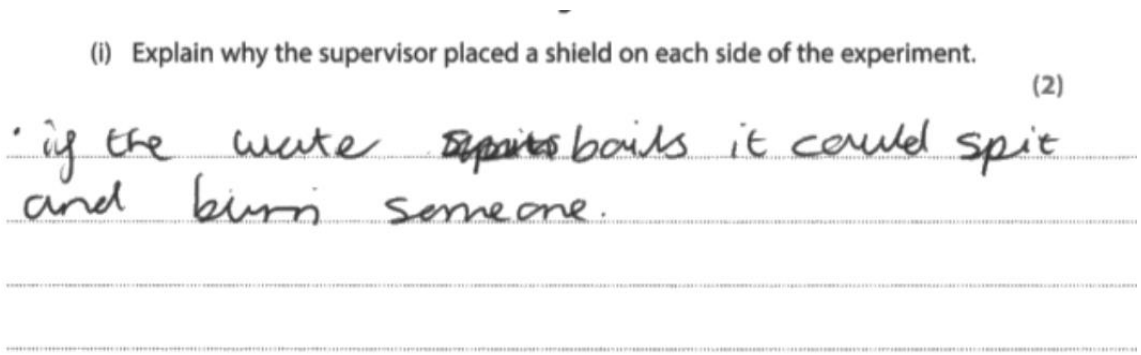


(i) Explain why the supervisor placed a shield on each side of the experiment.

(2)

To make sure that flame wouldn't go out due to wind.

Lead Examiner comment: *However, a common misconception was that the shield was there for safety purposes in case the alcohol burner exploded or spits.*



(i) Explain why the supervisor placed a shield on each side of the experiment.

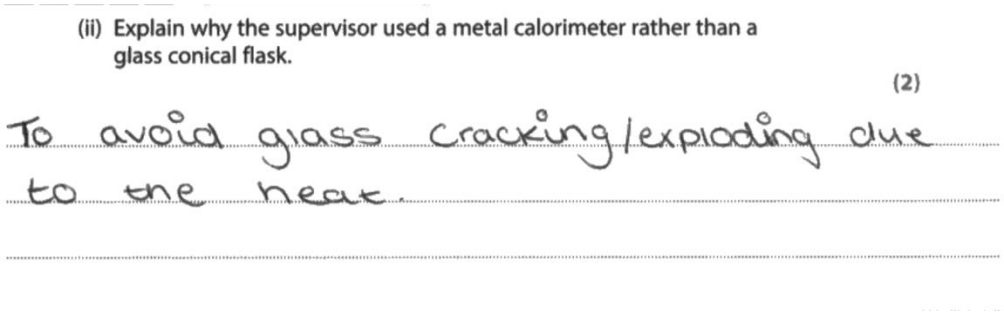
(2)

• if the water ~~Explodes~~ boils it could spit and burn someone.

Q2(a)(ii)

Learners were asked to explain why the supervisor used a metal calorieter rather than a glass conical flask. Some learners recognised that this was because metals are a better conductor of heat that glass, but many thought aagain that this was a safety preacution and that the metal was less likely to shatter than the glass. Some learners had the misconecption that metal was a better insultaor and would therefore keep the heat in the water, others thought that it would be because the metal would not burn.

Lead Examiner comment: *This example scored no marks.*

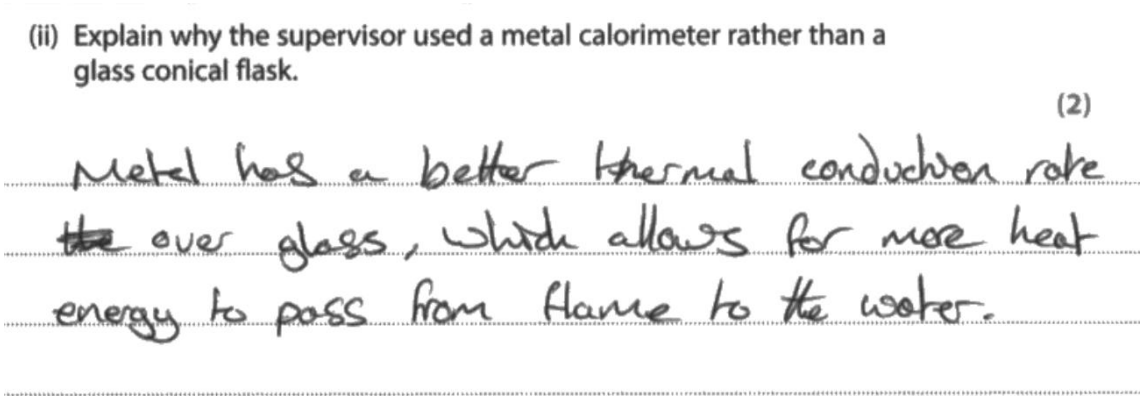


(ii) Explain why the supervisor used a metal calorimeter rather than a glass conical flask.

(2)

To avoid glass cracking/exploding due to the heat.

Lead Examiner comment: *This example shows a good answer that scored the 2 marks available.*



(ii) Explain why the supervisor used a metal calorimeter rather than a glass conical flask.

(2)

Metal has a better thermal conduction rate ~~the~~ over glass, which allows for more heat energy to pass from flame to the water.

Q2(b)(i)

This question asked learners to calculate the heat energy released by burning methanol, many learners were able to substitute into the equation correctly and evaluate it to gain both marks. Giving the joules as the unit was more difficult for learners and this is often where they lost a mark on this question.

Lead Examiner comment: *In this example, the learner correctly calculated the heat energy to gain 2 marks. If the learner had converted to kilojoules in their calculation, then Kj could have been accepted as the units*.

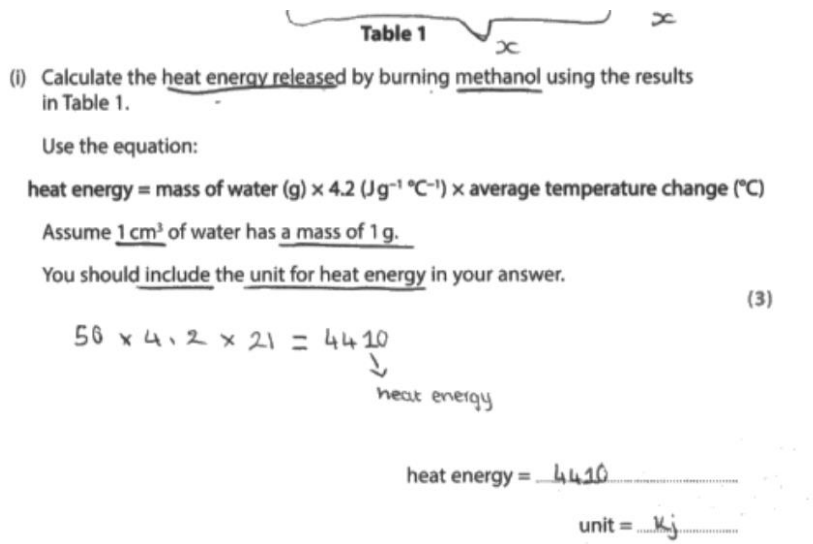


Table 1

(i) Calculate the heat energy released by burning methanol using the results in Table 1.

Use the equation:

heat energy = mass of water (g) × 4.2 ($J g^{-1} °C^{-1}$) × average temperature change (°C)

Assume 1 cm^3 of water has a mass of 1 g.

You should include the unit for heat energy in your answer.

(3)

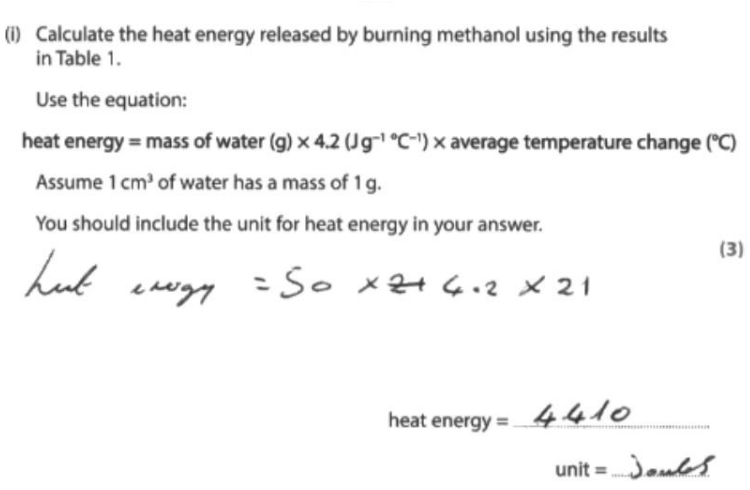
50 × 4.2 × 21 = 4410

heat energy

heat energy = 4410

unit = Kj

Lead Examiner comment: *This example gained the full 3 marks.*



(i) Calculate the heat energy released by burning methanol using the results in Table 1.

Use the equation:

heat energy = mass of water (g) × 4.2 ($J g^{-1} °C^{-1}$) × average temperature change (°C)

Assume 1 cm^3 of water has a mass of 1 g.

You should include the unit for heat energy in your answer.

(3)

heat energy = 50 × 21 × 4.2 × 21

heat energy = 4410

unit = Joules

Q2(b)(ii)

Learners found explaining a possible reason for the anomaly in the supervisor's results more difficult. Generic statements such as human error, measured the time wrong or the thermometer was broken did not gain credit. A common misconeption was that the calorimeter has not been left to cool sufficiently between readings, failing to take account of the method of taking an initial temperature reading.

Lead Examiner comment: *This example gained no marks as the answer was too vague, if the learner had stated that more volume may have been in the calorimeter then the mark could have been awarded.*

(ii) The supervisor has circled an anomaly in their results shown in Table 1.

They realised that the result was much lower than the others.

Explain **one** possible reason for this anomaly.

(2)

There could of been a different volume of water

Lead Examiner comment: *This example gained both marks for stating that there was more water and therefore it would take longer to heat up.*

(ii) The supervisor has circled an anomaly in their results shown in Table 1.

They realised that the result was much lower than the others.

Explain **one** possible reason for this anomaly.

(2)

The Volume of water may not have been measured accurately meaning there was more water therefore it takes longer to heat up.

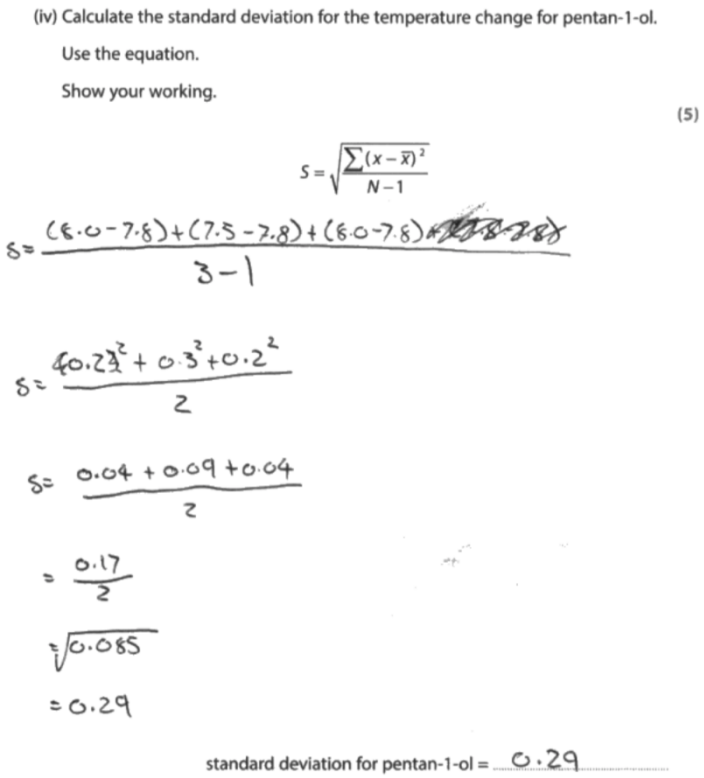
Q2(b)(iii)

In this question a good proportion of learners were able to understand that butan-1-ol had the least reliable set of results based on the standard deviations given in Table 1."

Q2(b)(iv)

This question asked learners to calculate the standard deviation for the temperature change for pentan-1-ol. Learners found this difficult, and few gained full marks.

Lead Examiner comment: *Learners that did well set their calculation in a logical way which enabled them to get the right answer.*



(iv) Calculate the standard deviation for the temperature change for pentan-1-ol.

Use the equation.

Show your working.

(5)

$$s = \sqrt{\frac{\sum (x - \bar{x})^2}{N - 1}}$$

$$s = \frac{(8.0 - 7.8) + (7.5 - 7.8) + (8.0 - 7.8)}{3 - 1}$$

$$s = \frac{0.2^2 + 0.3^2 + 0.2^2}{2}$$

$$s = \frac{0.04 + 0.09 + 0.04}{2}$$

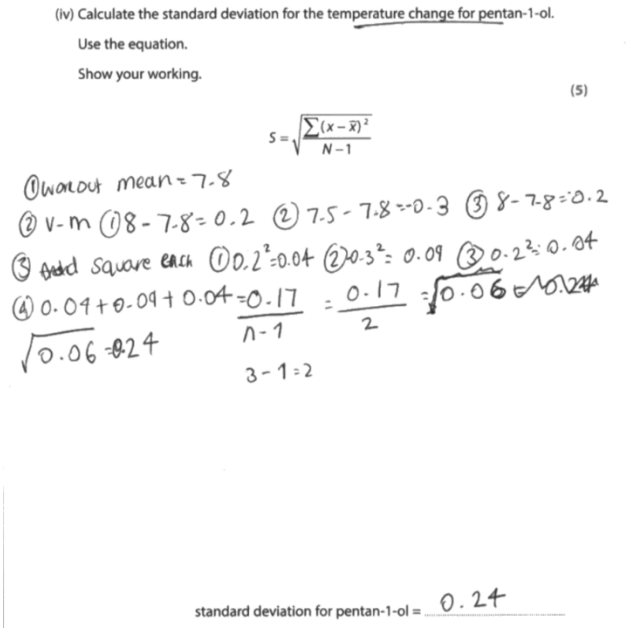
$$= \frac{0.17}{2}$$

$$= \sqrt{0.085}$$

$$= 0.29$$

standard deviation for pentan-1-ol = 0.29

Lead Examiner comment: *In this example the learner made one mistake in their working, as all of the working was shown, 4 marks could be awarded. If working had not been shown, 0.24 on the answerline would have scored 0 marks, this again highlights the importance of learners being taught to work in a logical way in calculations, showing their working.*


(iv) Calculate the standard deviation for the temperature change for pentan-1-ol.

Use the equation.

Show your working.

(5)

$$s = \sqrt{\frac{\sum (x - \bar{x})^2}{N - 1}}$$

① work out mean = 7.8

② x - m ① 8 - 7.8 = 0.2 ② 7.5 - 7.8 = -0.3 ③ 8 - 7.8 = 0.2

③ Add square each ① $0.2^2 = 0.04$ ② $0.3^2 = 0.09$ ③ $0.2^2 = 0.04$

④ $0.04 + 0.09 + 0.04 = 0.17$ $\frac{0.17}{n-1}$ $= \frac{0.17}{2}$ $= \sqrt{0.06}$ = 0.24

$\sqrt{0.06} = 0.24$

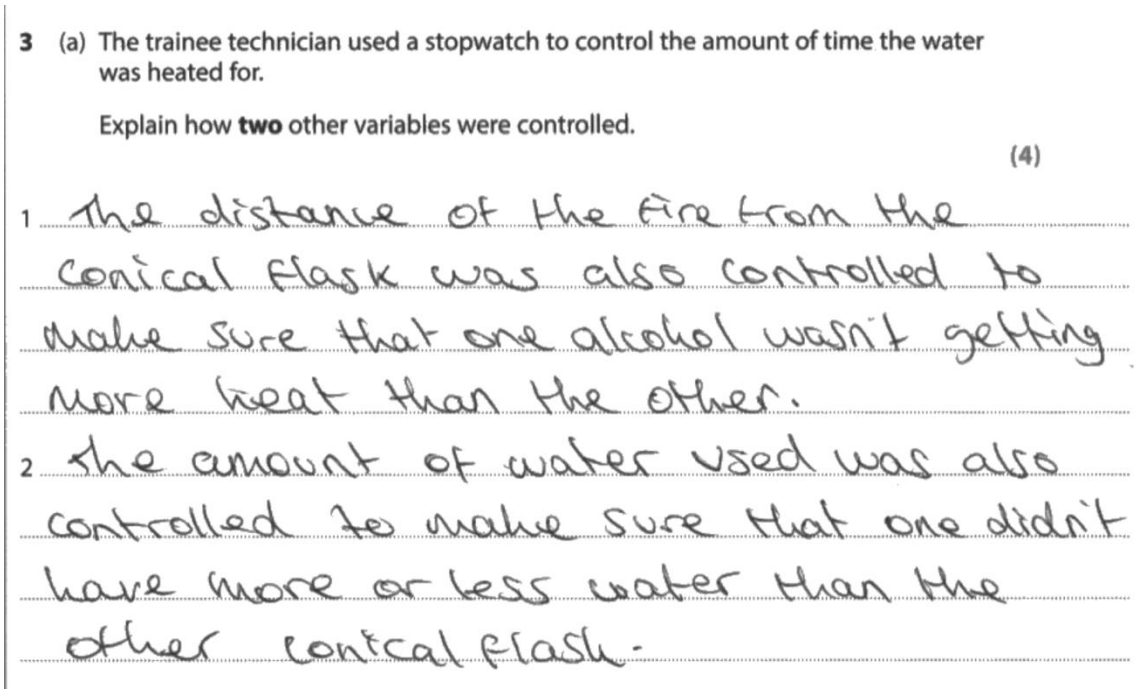
$3 - 1 = 2$

standard deviation for pentan-1-ol = 0.24

Q3(a)

This question focused back on the trainee technician's experiment and asked learners to explain how two variables were controlled. Learners were often able to identify two variables but did not go further to explain how these variables were controlled.

Lead Examiner comment: *This example scored two marks for stating that the distance from the flame to the conical flask was controlled and the amount of water used.*



3 (a) The trainee technician used a stopwatch to control the amount of time the water was heated for.

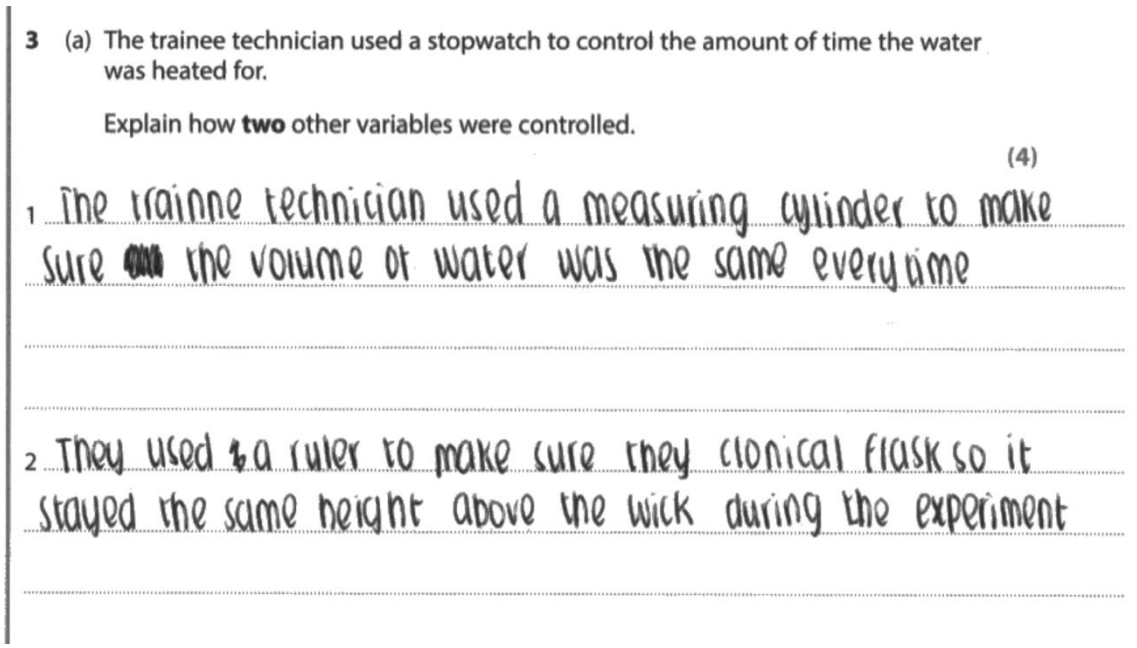
Explain how **two** other variables were controlled.

(4)

1 The distance of the fire from the conical flask was also controlled to make sure that one alcohol wasn't getting more heat than the other.

2 the amount of water used was also controlled to make sure that one didn't have more or less water than the other conical flask.

Lead Examiner comment: *In this example, the learner has given two variables, the volume of water and the height of the conical flask from the wick and stated how they were controlled, with a measuring cylinder and a ruler to gain 4 marks.*



3 (a) The trainee technician used a stopwatch to control the amount of time the water was heated for.

Explain how **two** other variables were controlled.

(4)

1 The trainne technician used a measuring cylinder to make sure the volume of water was the same everytime

2 They used a ruler to make sure they clonical flask so it stayed the same height above the wick during the experiment

Q3(b)

This question asked learners to explain two ways, other than changing the type of fuel from alcohols to hydrocarbons, that the trainee technician could extend their invesitogation.

As in Q3(a), learners could often give a correct suggestion as to how to extend the investigation to score a mark but could not explain it for the second mark. In some cases, learners gave ways to improve the initial method, such as using a digital rather than a traditional thermometer, rather than extending the investigation. These ideas did not gain credit.

Lead Examiner comment: *This answer gained 1 mark for burning the fuels for a different length of time.*

(b) One way to extend the trainee technician's investigation would be to change the type of fuel from alcohols to hydrocarbons.

Explain **two** other ways the trainee technician could extend their investigation.

(4)

1 use a digital thermometer than a liquid thermometer, to increase the amount of increments on the graph and table.

2 Change the amount of time the alcohol burner burns.

Summary

To improve in future series, learners should:

- Be exposed to practicals in the unit so they have first-hand experience of the methods, variables, safety considerations, equipment used and can discuss reasons for all of these
- They should practice drawing tables of date, ensuring that they give correct titles and units and are giving the data to the same number of decimal places
- They should practice calculating means and rounding the answers correctly and to the same number of decimal places as the original data provided
- Learners should continue to practice exam technique, ensuring that they know what is required by specific command words and know the difference in what is required from commands such as explain how and explain why
- Learners should ensure that they are specific with their answers, drawing on information from the stem, rather than giving vague or generic answers
- Practice calculations from the unit, ensuring that they are laying out their workings in a logical way

Individual Questions

Biology (Section 2)

Q4

Q4 is a levels-based question using 4 levels of attainment. For each level there is a range of 3 marks and once the level is decided by looking at the work as a whole, the quality of work presented within that level is assessed. The four levels of attainment are described by the generic mark scheme with a mark out of 12.

This question tests the ability of the learner to plan a scientific investigation. This includes the development of a hypothesis, the selection and justification of equipment, techniques and standard procedures, health and safety and methods of data collection including quantities to be measured, number and range of measurements to be taken, how the equipment is to be used, control variables and a brief method for data collection analysis.

The learners had to plan an investigation into sampling techniques. From the information provided the learners were required to select appropriate ecological sampling techniques to investigate the effect of abiotic factors.

Hypothesis

Most of the learners hypothesised that there would be more daisies on the north-facing field but very few were able to provide a scientific justification. A concerningly large number of learners made reference to the Sun rising in the North. There may have been a misunderstanding that has been carried over by students who either sat the February exam or used it as a past paper, where light inversely effected the plant growth due to dehydration and so learners suggested the sunniest field would have the lowest number of plants. Some learners also referred to the type of quadrat mentioned in that paper.

A high proportion of learners did not appreciate the south facing nature of the field but were still able to discuss light and photosynthesis as a factor relating to plant growth.

A substantial number of learners gave a null hypothesis, suggesting a confusion with statistical tests.

Equipment

The required equipment was generally well identified. Some learners gave a justification for each piece of equipment. Almost all learners selected quadrats and were able to select appropriate equipment for the practical.

Health and safety

The learners had a good understanding of the Health and Safety issues involved in carrying out this investigation. Most learners were able to correctly identify at least 1 risk. Some learners gave unnecessary health and safety advice, mimicking that which they would observe in a laboratory situation, e.g., goggles and a lab coat.

Method

Most learners were able to provide a method for a sampling technique and almost all suggested using a quadrat. Some learners incorrectly described methods relating to plant growth, including planting seeds, watering, and returning to check plant growth and digging up dandelions to measuring the roots.

Many learners understood the importance of random sampling and were able to provide detailed explanations why it would be necessary, but very few described how they could apply this to their investigation beyond placing their quadrat with some element of randomness, e.g., throwing it, doing so blindfolded, doing so after spinning around 5 times, etc. Those that did mention using a random number generator clearly did not understand its purpose. The method from Q5 was seen repeated often, i.e., dragging the quadrat along the transect.

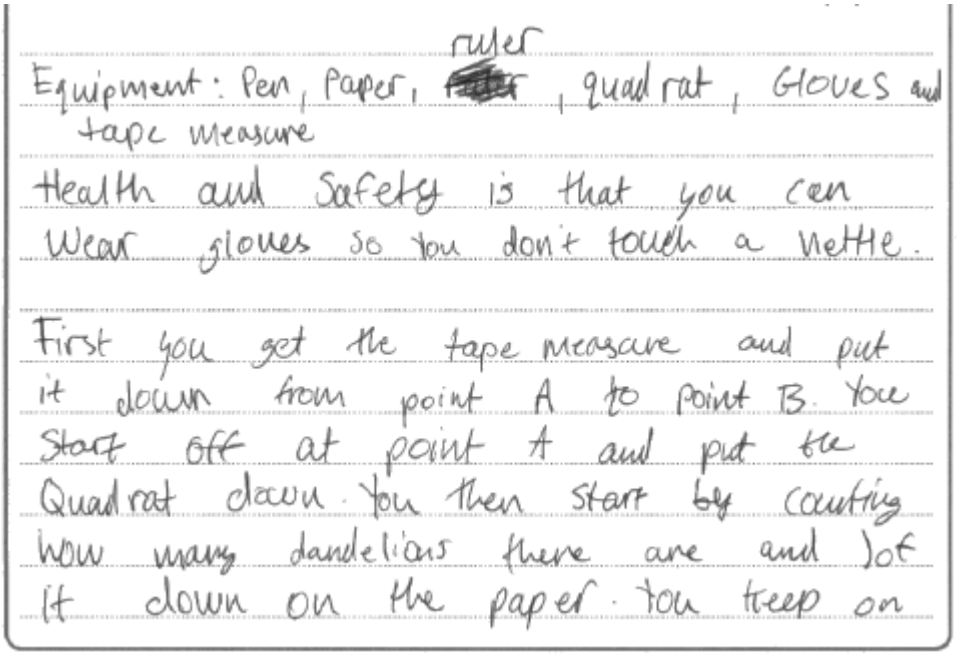
Many learners suggested obtaining only 3 to 5 samples per field, while others mentioned sampling in only one area.

Most learners understood the need to obtain multiple samples so that a mean could be calculated, but often failed to mention how this calculation would be carried out.

Many learners incorrectly identified the variables, commonly stating that controls included the direction the field was facing, light, or placement of the quadrat. Even so, learners could often still gain marks for these. Learners should be reminded that there should only be one independent and one dependent variable for the experiment and the other relevant variables should be controlled to ensure that the practical results are valid.

Data analysis was rarely mentioned and even then, only in vague suggestions of working out the average or drawing a graph. A few learners mentioned statistical analysis, and some gave an example of a table to record results in.

Lead Examiner comment: *This response was awarded Level 1, 3 marks.*
There is no hypothesis- but we judge these questions holistically. This would not necessarily limit a learner to Level 1 if everything else was sufficient.
The learner has given a very basic method. They have mentioned using a quadrat, although their method is unlikely to give valid results.
They have indicated some health and safety, and some equipment that they could use. They have attempted to give some control variables- although sunlight wouldn't be possible to control in a field. They have mentioned putting the data in a table, which suggests analysis.



Equipment: Pen, Paper, ruler, quadrat, Gloves and tape measure

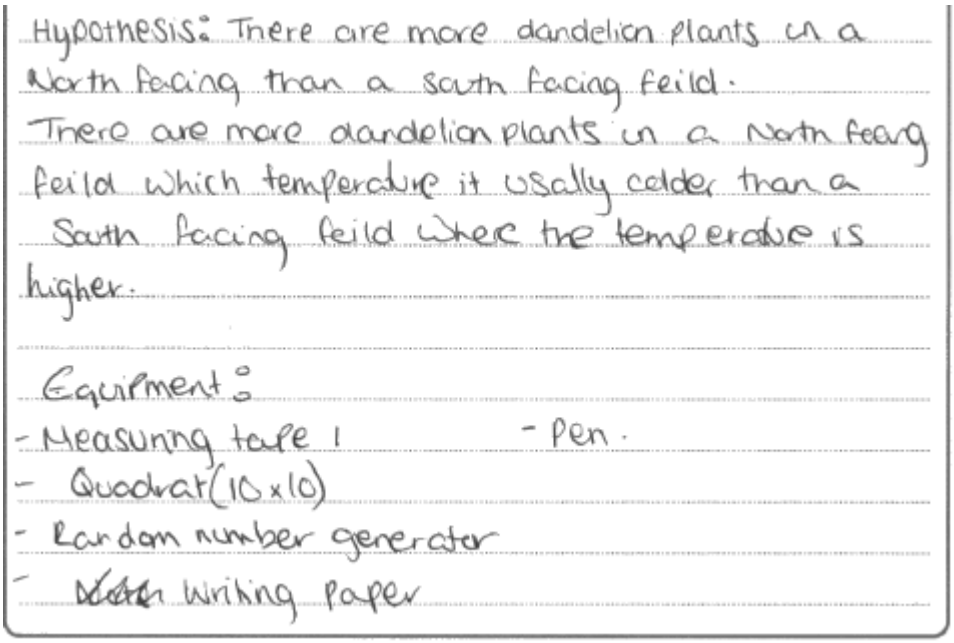
Health and Safety is that you can wear gloves so you don't touch a nettle.

First you get the tape measure and put it down from point A to point B. You start off at point A and put the Quadrat down. You then start by counting how many dandelions there are and put it down on the paper. You keep on

doing this until you have reached point B. When you have ~~thrown~~ thrown the quadrat down you should have soften the ruler and measured the dandelions. After you have collected all the data you should put it into a table.

The control variables you should keep the same are the amount of sunlight shining on the flowers. When you measure the flowers you should keep the same ruler.

Lead Examiner comment: *This response was awarded Level 2, 6 marks.*
There is a hypothesis, but it makes the common error that there would be more dandelions in the north facing than the south facing field. The learner has offered some scientific reasoning to partially support their hypothesis.
The learner has justified the equipment that they would intend to use. They have suggested that they would use a random number generator. They have indicated some health and safety considerations.
They have given one relevant control variable in the size of quadrat. The learner seems to have run out of time and has not been able to give a plan.



Hypothesis: There are more dandelion plants in a North facing than a south facing feild.
There are more dandelion plants in a North facing feild which temperature it usally colder than a South facing feild where the temperature is higher.

Equipment:
- Measuring tape
- Pen.
- Quadrat (10 x 10)
- Random number generator
- ~~Water~~ Writing Paper

A measuring tape is needed to measure the area the investigation will be taking place.
A random number generator is needed to pick a random number, so we can use that number between 1-10 ensures a random sample ~~& and toss for the~~ to look at the area we are sampling.
Quadrat is used to measure the sample of the dandelions or plants that are in the sample.
The quadrat should be thrown randomly with the person throwing it to close there eyes.
This ensures a random sample. ~~One the~~
10 x 10 quadrat is a big size for enough samples
A paper and pen is needed to note the amount of dandeleons seen in the quadrat squares

Health and Safety:
May be uneven bumps on the area so someone could fall or trip.
If the weather is very hot a person could be at risk of sunburn.
There could be some living threats like poisness animals that can attact a heman and cause harm.
Pollution in the air could cause potential respiratory problems.
If someone has hay fever the pollen could cause them to have a reaction.

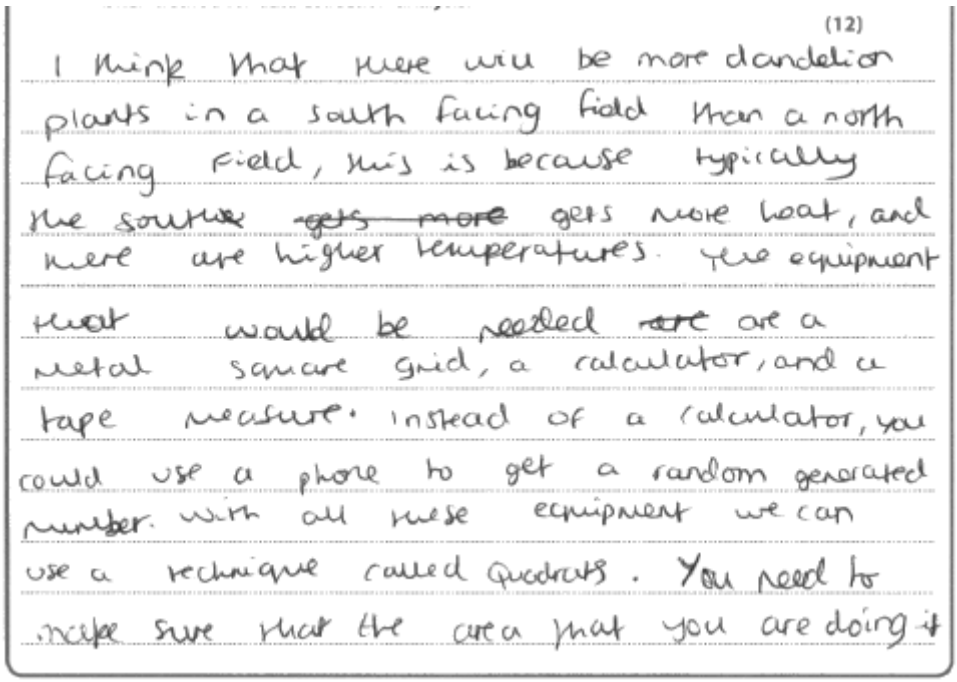
Method:

① ~~Place a~~ Pick a random number using a random number generator.

Control variables - Size of Quadrat,

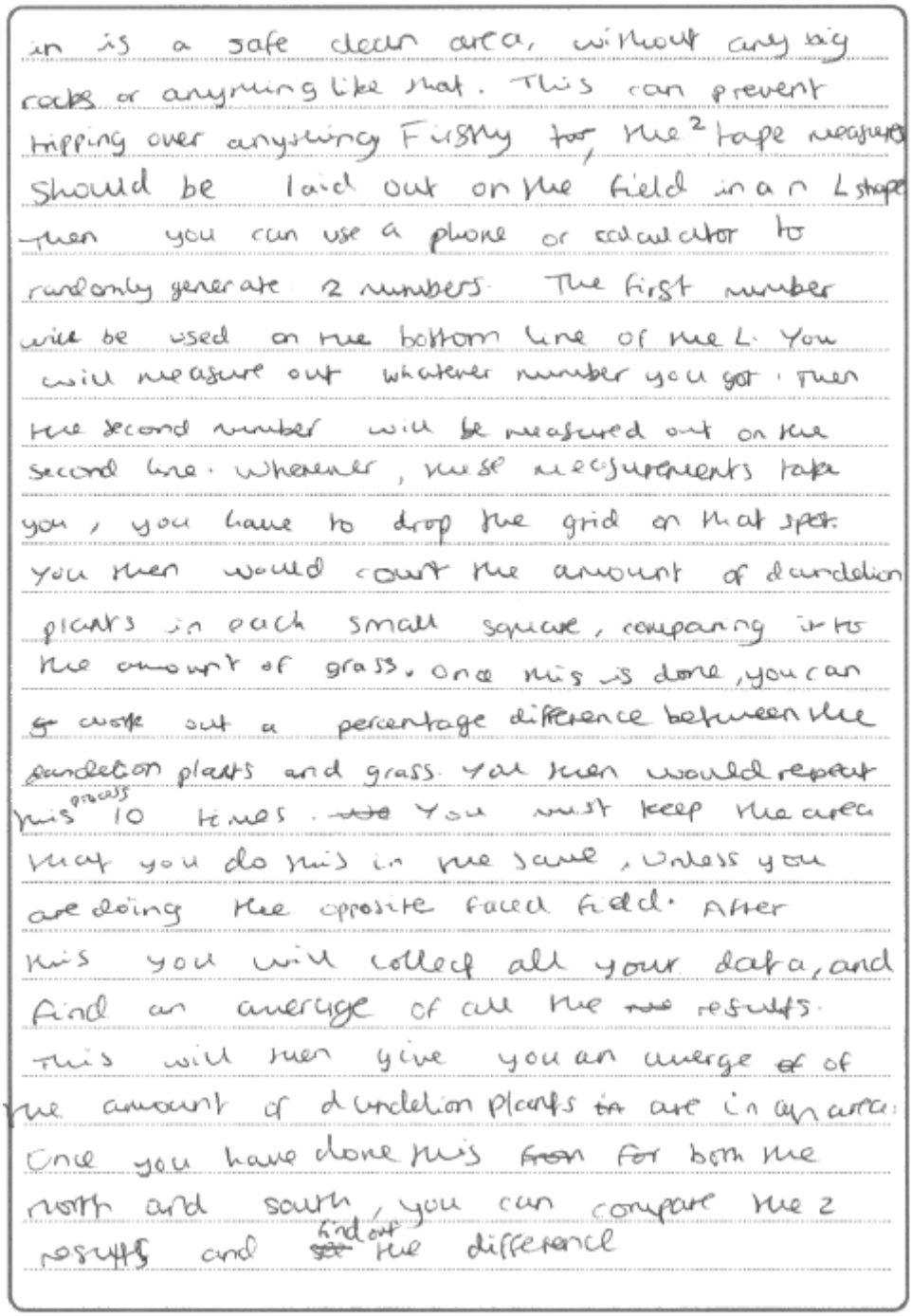
(Total for Question 4 = 12 marks)

Lead Examiner comment: *This response was awarded Level 4, 10 marks.*
There is a hypothesis and it is correct in stating that there would be more dandelions in the south field and it would have a higher temperature. The learner has offered some scientific reasoning to support their ideas.
The learner has justified the equipment that they would intend to use.
They have suggested that they would use a random number generator and have given details of how to use this. They have indicated health and safety considerations.
They have not given any control variables, the inclusion of which could have merited this answer full marks.
The learner has given a logical sequence which should lead to the collection of a reliable set of results.
They have given a suggestion for analysis as they have suggested calculating averages.



(12)

I think that there will be more dandelion plants in a south facing field than a north facing field, this is because typically the south ~~gets more~~ gets more heat, and there are higher temperatures. The equipment that would be needed ~~are~~ are a metal square grid, a calculator, and a tape measure. Instead of a calculator, you could use a phone to get a random generated number. With all these equipment we can use a technique called Quadrats. You need to make sure that the area that you are doing it



in is a safe clear area, without any big rocks or anything like that. This can prevent tripping over anything. Firstly for the m^2 shape measured should be laid out on the field in an L shape then you can use a phone or calculator to randomly generate 2 numbers. The first number will be used on the bottom line of the L. You will measure out whatever number you got. Then the second number will be measured out on the second line. Wherever these measurements take you, you have to drop the grid on that spot. You then would count the amount of dandelion plants in each small square, comparing it to the amount of grass. Once this is done, you can ~~g~~ work out a percentage difference between the dandelion plants and grass. You then would repeat this process 10 times. ~~You~~ You must keep the area that you do this in the same, unless you are doing the opposite faced field. After this you will collect all your data, and find an average of all the ~~me~~ results. This will then give you an average ~~of~~ of the amount of dandelion plants ~~in~~ are in an area. Once you have done this ~~from~~ for both the north and south, you can compare the 2 results and ~~see~~ find out the difference

Q5

This question was poorly answered compared to Q4, with far fewer learners obtaining the higher marks.

A significant number of learners wrote out a method but provided no evaluation.

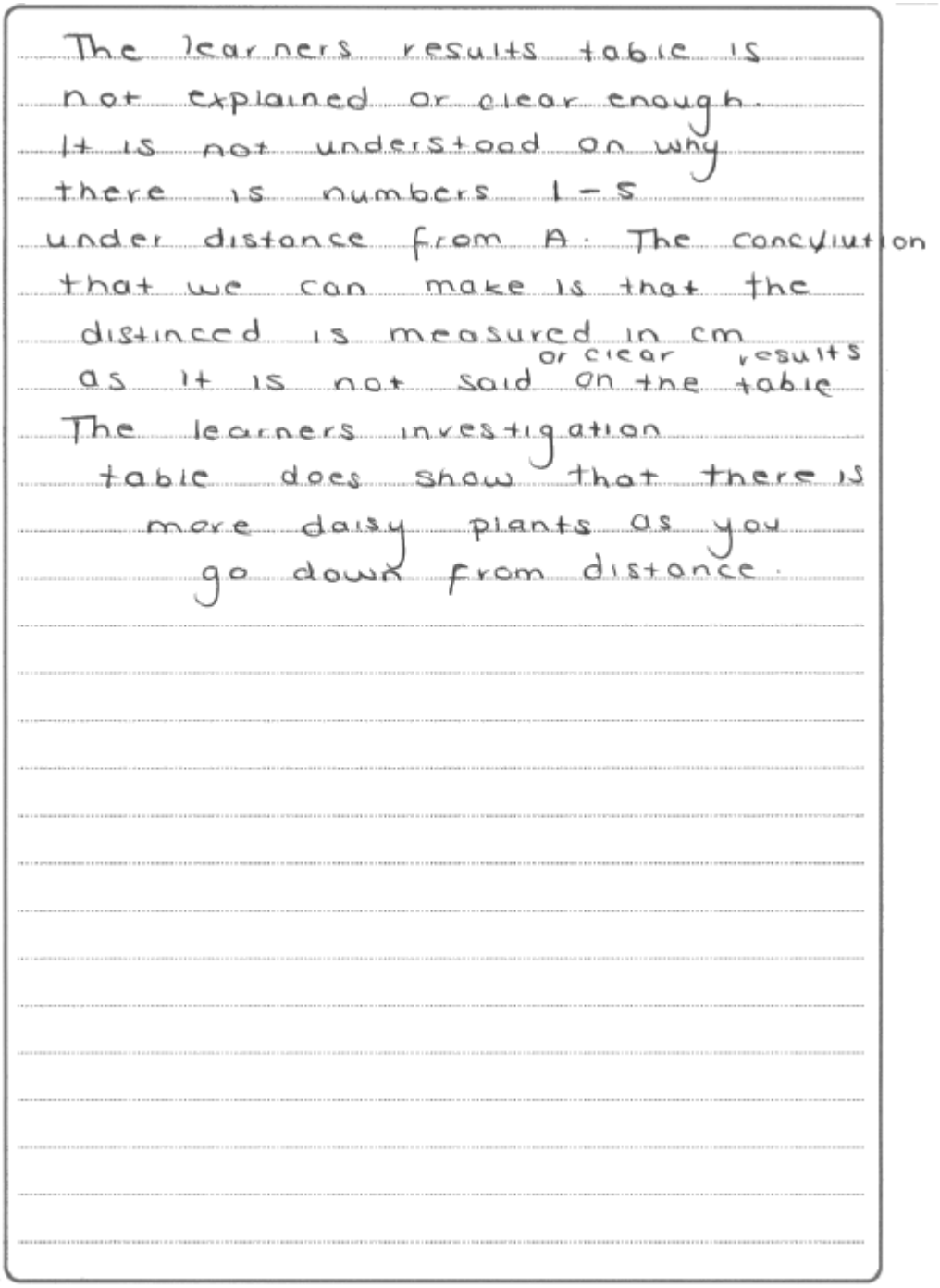
When considering the method used, whilst learners could see errors and omissions in the method, few were able to explain why it was important to specify.

Many were able to state ideas relating to repeats, distances and units. A lot of learners suggested that a line transect would give biased results and that an improvement would be to do random sampling. This was a very common idea and may suggest a misconception over the use of different sampling techniques.

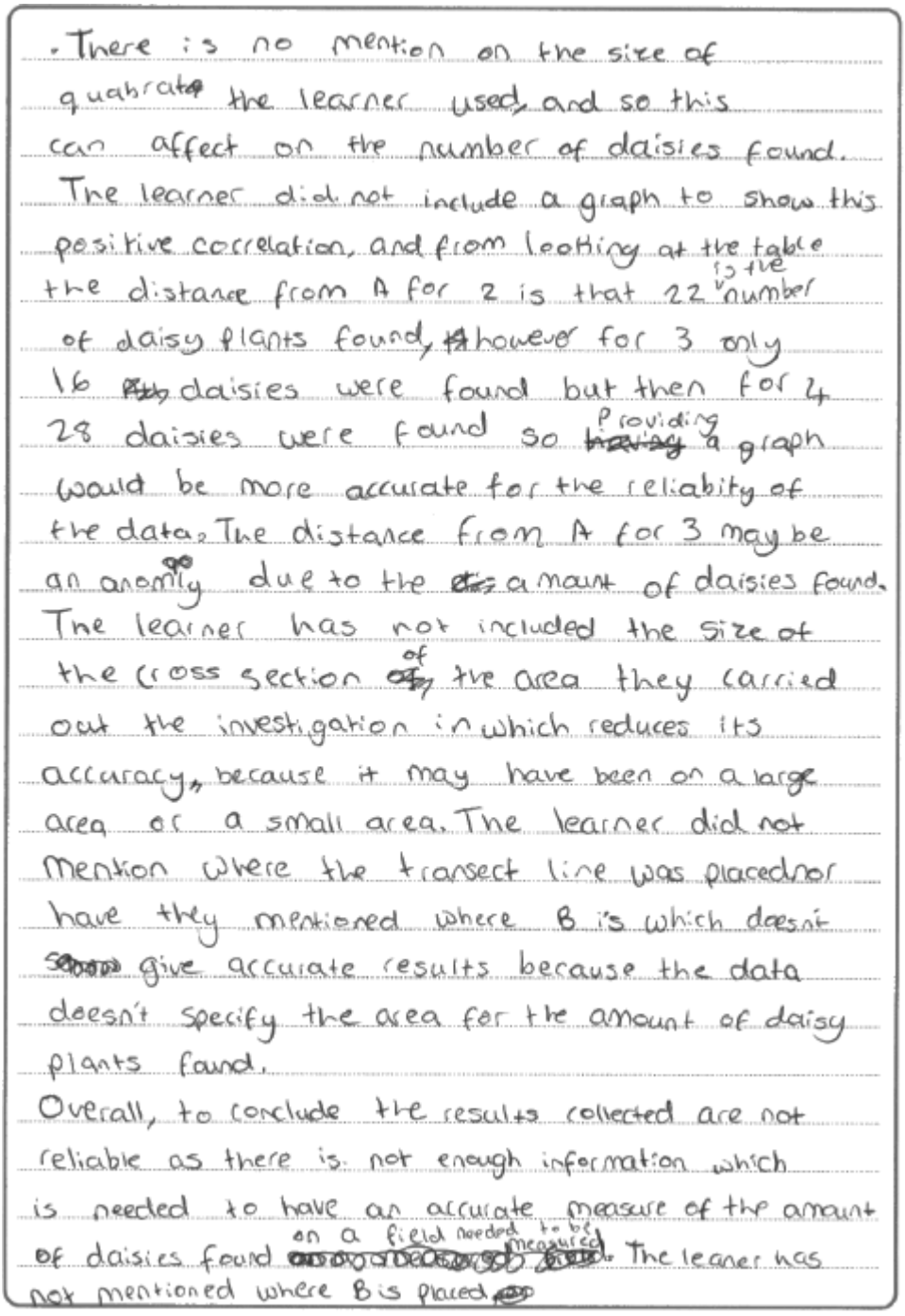
Some learners used the word 'measurement', and it was unclear whether this related to units or distances, it would be useful for teachers to ensure learners are clear with their wording so that marks can be apportioned accordingly. Learners who discussed the lack of detail relating to the intervals between measurements often failed to offer a line of argument and state why this could affect the results. Some of the better responses seen talked about this causing more samples to be taken in one area (heavier/lighter with plants) or the same area partially sampled again.

Most learners were able to identify that there was an anomaly in the results and some tried to suggest why this might occur. Some were able to relate this to the accuracy of the conclusion. The 'anomaly' at distance 3 was sometimes linked by some learners to growing conditions and to the image they were given for the area, e.g., the water at the centre.

Lead Examiner comment: *This response was awarded Level 1, 2 marks. The learner has highlighted a shortcoming of the method and is correct that the distances from A could be clearer. They have provided a brief statement to support the conclusion but it is lacking in detail.*

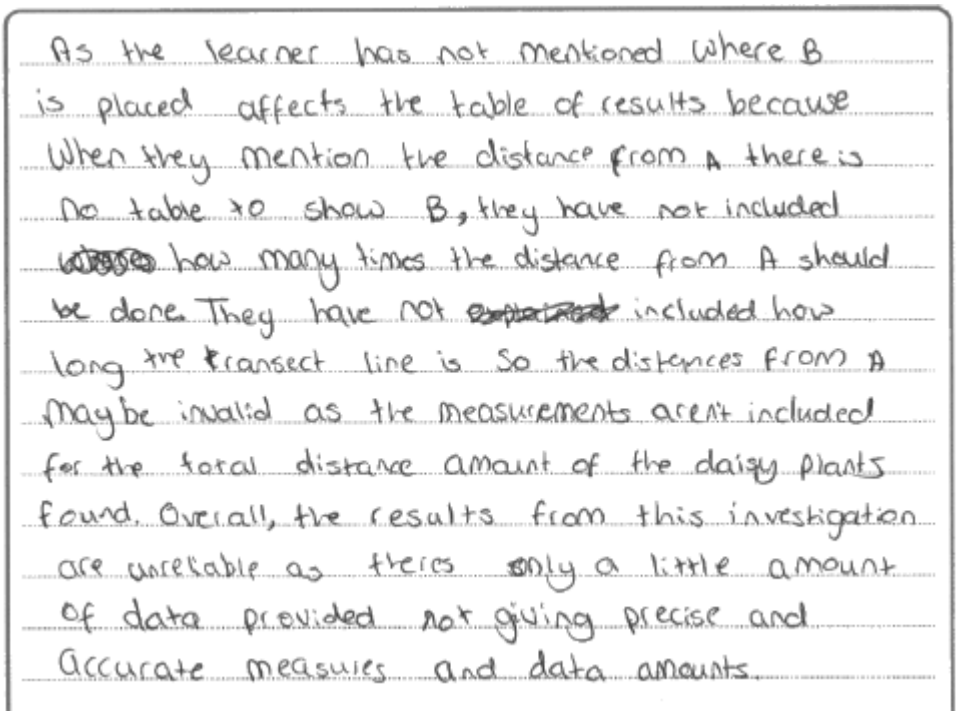

The learners results table is not explained or clear enough. It is not understood on why there is numbers 1-5 under distance from A. The conclusion that we can make is that the distinced is measured in cm as it is not said on the table or clear results
The learners investigation table does show that there is more daisy plants as you go down from distance.

Lead Examiner comment: *This response was awarded Level 2, 5 Marks.*
The learner has made a number of points, but has repeated themselves a number of times.
They have mentioned that the size of the quadrat is unknown, as is the distance.
The learner has discussed the anomalous result at distance 3 and suggested that more data and data analysis is needed.



- There is no mention on the size of quadrats the learner used, and so this can affect on the number of daisies found. The learner did not include a graph to show this positive correlation, and from looking at the table the distance from A for 2 is that 22 is the number of daisy plants found, however for 3 only 16 daisies were found but then for 4 28 daisies were found so providing a graph would be more accurate for the reliabity of the data. The distance from A for 3 may be an anomly due to the amount of daisies found. The learner has not included the size of the cross section of the area they carried out the investigation in which reduces its accuracy, because it may have been on a large area or a small area. The learner did not mention where the transect line was placed nor have they mentioned where B is which doesn't give accurate results because the data doesn't specify the area for the amount of daisy plants found.

Overall, to conclude the results collected are not reliable as there is not enough information which is needed to have an accurate measure of the amount of daisies found on a field needed to be measured. The leaner has not mentioned where B is placed



As the learner has not mentioned where B is placed affects the table of results because when they mention the distance from A there is no table to show B, they have not included how many times the distance from A should be done. They have not included how long the transect line is so the distances from A may be invalid as the measurements aren't included for the total distance amount of the daisy plants found. Overall, the results from this investigation are unreliable as theirs only a little amount of data provided not giving precise and accurate measures and data amounts.

Lead Examiner comment: *This response was awarded Level 3, 8 Marks.*
The learner does not have to cover every point of the indicative content. It is just a guide as the learner may think of other merit worthy points and develop them with complete lines of argument to gain further marks.
The learner has highlighted a number of flaws in the method provided. They are correct in questioning the distances as they are not clear and the units are missing.
They have questioned that little is known about the area and have highlighted the issues with the pond in the middle and how that might affect the results.
They have touched on the issue of trampling, but this is not related to the sliding of the quadrate and that the method doesn't include control variables.
They have highlighted the lack of repeats and how this therefore means anomalies cannot be identified.
They have highlighted the value at distance 3 as a possible anomalous result, but has noticed that the conclusion is partly supported by the data.

Method: Learner has not mentioned the location of quadrants placed along the transect line for all fore tests

- learner has not mentioned the distance from Point A to Point B in any unit of measurement
- learner did not mention whether or not he used an isolated area to perform his experiment
- learner did not mension the location of the experiment
- learner did not mension how he taken the Pond on the middle of the test area into account
- learner has not stated weather or not he repeated the experiment so that he can produce more reliable results
- Pond on the middle of area would have a lack of daisy plants as it is in the transect lone
- using isolated area would reduce the risk of trampling in the transect area, which would make the results more reliable
- learner did not mension any Controlle Variables
- Results: - Since Learner did not repeat the test a certain number of times, the results he collected are not reliable, however within the results he collected, tests 1, 2, 4, and 5 shown that the further away from a the more daisys there are since in 1st test there are 14 daisies

and in 5th there are 36 tests, but on 3rd best there are 16 classes. thus is less the factor the 2nd and 4th best

-Conclusion: Since learner did not repeat the test a certain number of times, it is unclear weather or not his Conclusion is supported by his results and Correct, however on the third test, we can see that the results obtained (no. of classes) is less then the no. of classes on the 2nd best, this was therefore ~~the [illegible] a positive [illegible] no. of classes and [illegible] A~~ it is unclear weather or ~~[illegible]~~ not there is any possible Correlation between the number of ~~dates~~ classes and the further the distance you get from A

(Total for Question 5 = 8 marks)

TOTAL FOR SECTION 2 = 20 MARKS
TOTAL FOR PAPER = 60 MARKS

Summary

To improve in future series, learners should:

- Plan their time across the whole paper so that they are able to finish all of the questions set in full, they should ensure that they answer all parts of the question and to give developed answers rather than giving generic or basic ideas only
- Learners should be taught about the difference between accuracy and reliability
- Familiarise with practical methods and the format of written practical methods
- Learners should support their hypothesis with scientific knowledge.
- Learners should try to give logical methods with specific values for the independent, dependent and control variables
- Learners should consider why control variables need to be controlled and how this can be done
- Learners should justify their equipment choices
- Learners can consider the use of annotated diagrams to support their response

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